CLAIMS

We claim:

1. A method for generating coefficients for a set of convolution kernels for use in interpolating pixel values in an image sensor, wherein said image sensor comprises a pixel array overlaid with a pattern of *f* selectively transmissive filters so that each pixel element of said pixel array is disposed to capture only one of a plurality of color spectra of visible light, said method comprising:

generating ideal sensor data representative of a test image in a first color plane, said test image comprising a plurality of colors;

generating sensor data of said test image, said sensor data indicative of an image of said test image captured using said image sensor, said sensor data being a two dimensional array of pixel data;

generating *f* data matrices, each data matrix comprising pixel data from a plurality of neighborhoods of pixels in said pixel array, each row of said data matrix including said pixel data of one neighborhood of pixels, each of said neighborhoods of pixels having m rows and n columns and surrounding a center pixel, wherein each data matrix includes pixel data corresponding to one of said *f* selectively transmissive filters superimposed on said center pixel of each neighborhood of pixels; and

determining said coefficients for *f* convolution kernels using said ideal sensor data, said *f* data matrices and by applying one or more constraints.

2. The method of claim 1, wherein said generating *f* data matrices comprises:

generating a first matrix comprising said pixel data from said plurality of neighborhoods of pixels in said pixel array, each row of said first matrix including said pixel data of one neighborhood of pixels, each of said neighborhoods of pixels having m rows and n columns and surrounding a center pixel; and

forming said *f* data matrices by dividing rows of said first matrix based on said *f* selectively transmissive filters superimposed on said center pixel of each neighborhood of pixels.

3. The method of claim 1, wherein said determining said coefficients comprises:

forming an diagonalized matrix using said *f* data matrices;

forming *f* ideal matrices based on said ideal sensor data, each of said *f* ideal matrices including ideal sensor data associated with a respective one of said *f* selectively transmissive filters superimposed on said center pixel of each neighborhood of pixels;

generating a constraint matrix based on said one or more constraints, said one or more constraints being expressed as linear equations in terms of one or more parameters;

multiplying said diagonalized matrix with said constraint matrix to generate a constrained data matrix;

determining using least square regression said one or more parameters based on said constrained data matrix and said ideal sensor data; and

multiplying said constraint matrix and said one or more parameters to generate said coefficients.

4. The method of claim 3, wherein said forming an diagonalized matrix using said *f* data matrices comprises:

placing said *f* data matrices along a diagonal of said diagonalized matrix; and

placing the value zero in entries not occupied by said *f* data matrices.

5. The method of claim 3, wherein said determining using least square regression said one or more parameters based on said constrained data matrix and said ideal sensor data comprises:

solving the matrix equation CM*P=I for P,

wherein CM is said constrained data matrix, P is a matrix representing said one or more parameters and I is a matrix representing said *f* ideal matrices.

6. The method of claim 3, wherein said generating a constraint matrix based on said one or more constraints comprises:

selecting one or more constraints;

specifying restrictions on said coefficients for *f* convolution kernels based on said one or more constraints;

expressing said restrictions in one or more linear equations in terms of said coefficients;

solving said one or more linear equations in terms of said one or more parameters, said one or more parameters being independent variables of said one or more linear equations;

expressing each of said coefficients as a linear combination of said one or more parameters based on said one or more linear equations; and

constructing said constraint matrix by transforming said linear combinations of said one or

more parameters for all of said coefficients into a matrix representation.

7. The method of claim 6, wherein said constructing said constraint matrix comprises:

expressing said linear combinations as a matrix equation C=CT*P, where C is a matrix representing said coefficients for *f* convolution kernels, CT is said constraint matrix and P is a matrix representing said one or more parameters.

8. The method of claim 6, wherein said one or more constraints comprise any one of color uniformity, vertical edge uniformity, horizontal edge uniformity, diagonal edge uniformity, spatial symmetry, a zero gain and a set gain in said full color image.

9. The method of claim 6, wherein said expressing said restrictions in one or more linear equations comprises expressing said restrictions as a sum of a first set of coefficients in a first one of said *f* convolution kernels as being equal to a sum of a second set of coefficients in a second one of said *f* convolution kernels.

10. The method of claim 1, wherein said generating sensor data of said test image comprises capturing an image of said test image using said image sensor.

11. The method of claim 1, wherein said generating sensor data of said test image comprises generating said sensor data by simulating characteristics of said image sensor.

12. The method of claim 1, wherein said test image is a random color noise image.

13. The method of claim 1, wherein said coefficients are applied in interpolating pixel values for deriving pixel values for a full color image, and said one or more constraints define one or more characteristics of said full color image.

14. The method of claim 13, wherein said one or more characteristics comprise any one of color uniformity, edge uniformity, spatial symmetry, and a set gain in said full color image.

15. The method of claim 1, wherein said coefficients for *f* convolution kernels are applied in interpolating pixel values for deriving pixel values in a first color plane of a full color image, and said determining said coefficients is repeated to determine said coefficients for *f* convolution kernels for deriving pixel values in a second color plane of said full color image.

16. The method of claim 1, wherein said determining said coefficients for *f* convolution kernels comprises determining coefficients for *f* convolution kernels for a first color plane in a full color image and coefficients for *f* convolution kernels for a second color plane in said full color image simultaneously.

17. The method of claim 1, wherein each neighborhood of pixels in said pixel array is an n×n neighborhood of pixels.

18. The method of claim 17, wherein said n×n neighborhood of pixels is an 5×5 neighborhood of pixels.

19. The method of claim 1, wherein said coefficients for *f* convolution kernels are applied in interpolating pixel

values for deriving pixel values in a first color plane of a full color image, said full color image being expressed in a first color space different than a color space of said *f* selectively transmissive filters.

20. The method of claim 19, wherein said full color image is expressed in a Y/Cb/Cr color space and said *f* selectively transmissive filters are expressed in a RGB color space.